Electricity Review:

Variable	Unit
I (current)	A (amps)
R (resistance)	Ω (ohms)
V (voltage)	V (volts)
P (power)	W (watts)
q (charge)	C (coulombs)
F (force)	N (newtons)

Constant: $k = 8.99E9\ N \cdot m^2/C^2$

Coulomb's constant

r (distance between charges)	m (meters)
E (electric field)	N/C (newtons per coulomb)
U_e (electric potential energy)	J (joules)
d (displacement)	m (meters)

Two charges are separated by 5 cm.

Charge 1 = 60 E -6 C.

Charge 2 = -45 E -6 C.

Find net Force between charges.

$$F_{21} = \frac{k\,|q_1|\,|q_2|}{r_{12}^2}$$

$$= \frac{(8.99E9\ N\cdot m^2/C^2)(60E\text{-}6\ C)(45E\text{-}6\ C)}{(.05\ m)^2}$$

$$= 9709\ N$$

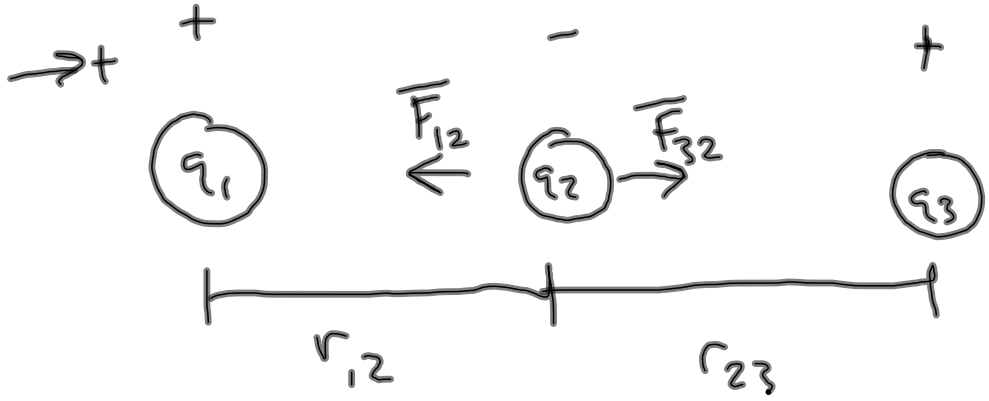
Three charges in a line.

$q_1 = 60E-6\ C$

$q_2 = -45E-6\ C$ $\quad r_{12} = 5\ cm$

$q_3 = 75E-6\ C.$ $\quad r_{23} = 7\ cm$

Find net force on q_2.



$$\sum \vec{F}_2 = \vec{F}_{12} + \vec{F}_{32}$$

$$= -\frac{k|q_1||q_2|}{r_{12}^2} + \frac{k|q_2||q_3|}{r_{23}^2}$$

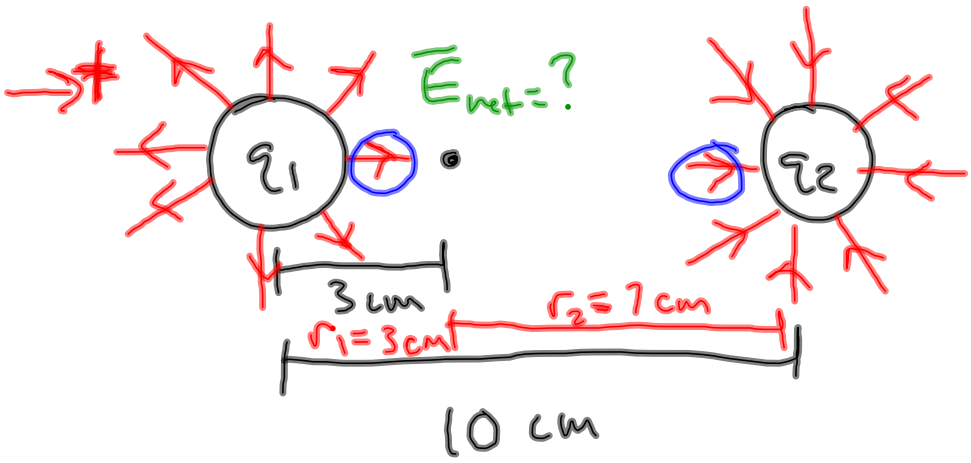
$$= -\frac{k(60E-6\ C)(45E-6\ C)}{(.05\ m)^2} + \frac{k(45E-6\ C)(75E-6\ C)}{(.07\ m)^2}$$

$$= -3517\ N$$

$q_1 = 80\ \mu C$

$q_2 = -50\ \mu C$ $\quad r_{12} = 10\ cm$

Find ^{net} electric field at point 3 cm from q_1 (between the charges).



$$\vec{E}_{net} = \vec{E}_1 + \vec{E}_2$$

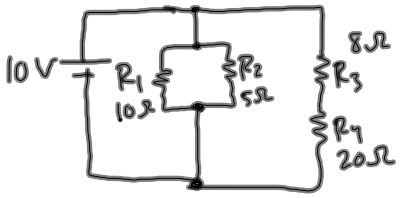
$$= \frac{k|q_1|}{r_1^2} + \frac{k|q_2|}{r_2^2}$$

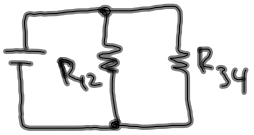
$$= \frac{k(80E-6)}{(.03\,m)^2} + \frac{k(50E-6C)}{(.07\,m)^2}$$

$$= 7.99E8\ N/C + 9.17E7\ N/C$$

$$= 8.91E8\ N/C$$

Find all V's and I's:



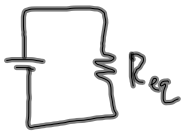


$$\frac{1}{R_{12}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R_{12} = 3.33\,\Omega$$

$$R_{34} = R_3 + R_4$$

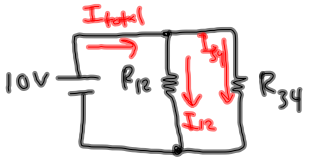
$$= 28\,\Omega$$



$$\frac{1}{R_{eq}} = \frac{1}{R_{12}} + \frac{1}{R_{34}}$$

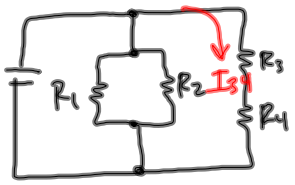
$$R_{eq} = 2.97\,\Omega$$

$$I_{total} = \frac{V_{battery}}{R_{eq}} = \frac{10\,V}{2.97\,\Omega} = 3.35\,A$$



$$I_{12} = \frac{V_{battery}}{R_{12}} = 3.00\,A$$

$$I_{34} = \frac{V_{battery}}{R_{34}} = 0.357\,A$$



$$I_1 = \frac{V_{battery}}{R_1} = 1.00\,A$$

$$I_2 = \frac{V_{battery}}{R_2} = 2.00\,A$$

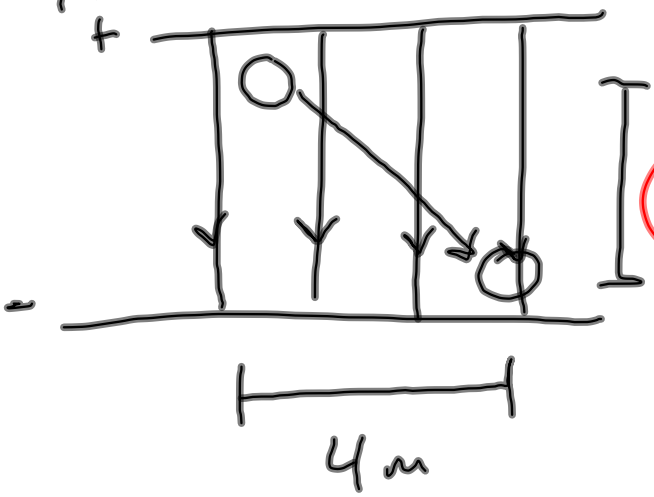
$$V_3 = I_{34} R_3 = 2.86\,V$$

$$V_4 = I_{34} R_4 = 7.14\,V$$

$V_1 = 10\,V$
$I_1 = 1\,A$
$V_2 = 10\,V$
$I_2 = 2\,A$

$V_3 = 2.86\,V$
$I_3 = 0.357\,A$
$V_4 = 7.14\,V$
$I_4 = 0.357\,A$

Find ΔU_e



$q = 60E-6\ C$

$E = 10\ N/C$

Same direction as E-field

$$\Delta U_e = -qEd$$

$$= -(60E-6\ C)(10\ N/C)(5\ m)$$

$$= -0.003\ J$$